

# Modeling the Effect of Climate Change on Rare Genotypes in Nature

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Numerical simulations are employed to model the impact of rare genetic types (or genotypes) experiencing climate change over a long time scale. The physical appearance of many genotypes is impacted by enzymatic functioning. Some enzymes are temperature sensitive and may therefore be impacted by global warming. When enzyme expression changes traits like pigmentation, can be affected dramatically. Genetic polymorphism, where at least two different types of the same species exist, are often maintained by natural selection. There are two color types of mosquitofish (*Gambusia holbrooki*), melanic (black spotted) and silver. Even though the mosquitofish are one of the most abundant fish species in the southeastern US, the melanic genotype is quite rare. All the progeny of silver mosquitofish are born silver and on average about 20% of the progeny of melanic fish are also silver. However in some populations cold exposure is required for the progeny of melanic fish to develop melanism. Without cold exposure these fish remain silver.

Climate change, resulting in rising water temperatures may affect the expression patterns of the rare genotypes that require cold exposure to turn melanic. To simulate the effect of the rising temperature on the inheritance of melanism parameter we used three different functions as a linear function, a step function, and a random function. In each case simulations reveal that the climate change will have a devastating effect on the melanic genotypes that require cold exposure to express melanism - they will go extinct after a finite number of years. We also report on the effect of a variety of initial conditions on the population growth/decay and the sensitivity of the population to fitness changes.